Foreword

Two themes emerge from this issue of the *ICF Quarterly Report*. The first theme is evident in LLNL's active pursuit of experiments to test applications of high-power lasers to basic science and management of our nation's nuclear stockpile. The second theme appears in the increasing maturity of the scientific and technological progress within target experiments, theory, and fabrication for fusion ignition with the National Ignition Facility (NIF). These two themes are closely linked, and progress in one area aids the other.

The issue includes two companion articles, "Absolute Equation of State Measurements of Compressed Liquid Deuterium Using Nova" and "Characterization of Laser-Driven Shock Waves Using Interferometry." These articles describe new capabilities for understanding the physics of matter at high densities and pressure. An "equation of state" relates the energy and pressure of a material to density and temperature, and is fundamental to modeling its behavior. The first article details experiments measuring the properties of liquid deuterium in a pressure range (1 to 2 Mbars) critical for ignition targets on NIF. New data show that deuterium is "softer" than calculated earlier, easing stability concerns for an imploding capsule and giving higher predicted gain. The second article describes the novel experimental techniques used to measure the equation of state. A laser interferometer accurately characterizes the shock wave compressing the material, as well as possible preheating effects, giving high confidence in the data. The new method potentially applies to a wide variety of materials.

The article "Supernova Hydrodynamics Experiments on the Nova Laser" describes the use of laser-heated hohlraum experiments to address an important and timely problem in astrophysics. Observations over the last decade of the explosion of the supernova SN1987A have led to radical changes in the understanding of these violent events and a need for improved modeling of the complex hydrodynamics involved. Initial experiments on Nova produced well controlled plasma conditions, analogous to conditions in SN1987A, allowing detailed measurements of instability development. Comparisons between the Nova experiments and the models will allow tests of the supernova modeling.

The use of composite materials in hohlraum walls could significantly improve our ability to do indirect-drive inertial confinment fusion (ICF), increasing the ignition margin for NIF, as reported in "The Rosseland Mean Opacity of Composite Material at High Temperatures." In the indirect-drive NIF ignition target, absorption of x-ray energy in the hohlraum walls dominates energy balance. Increasing the opacity of the walls by combining gold and gadolinium limits the penetration of the heat wave and should decrease the wall losses by as much as 160 kJ (15%) for NIF.

Target fabrication continues to play a key role in the development of ICF. NIF ignition targets will require a very uniform layer of cryogenic deuterium–tritium, possibly supported on a low-density-foam shell to improve uniformity. Suitable shells composed of resorcinol-formaldehyde aerogel have been successfully fabricated, and are described in the article "Low-Density-Foam Shells." New methods to stimulate rapid gelling and control water content of the shells proved essential to meeting the target design requirements.

The final article, "Tetrahedral Hohlraums," describes a novel geometry for indirect-drive ICF with advantages for improved symmetry of x-ray illumination of the capsule. Good illumination symmetry is critical for reaching the high radial convergence needed for ignition. The new geometry yields significantly better symmetry in the presence of laser pointing errors than standard cylindrical hohlraums.

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